THE DEPARTMENT OF

Agricultural & Biological ENGINEERING

AT
PURDUE UNIVERSITY
PRESENTS:

THE 3RD ANNUAL ABE-GSA INDUSTRIAL RESEARCH SYMPOSIUM

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PROCEEDINGS OF THE 3rd ANNUAL ABE-GSA INDUSTRIAL RESEARCH SYMPOSIUM

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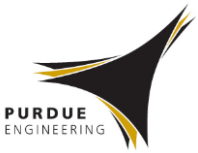

S Y M P O S I U M O R G A N I Z E R S

Symposium Chair:
Jinsha Li

Symposium Coordinators:
Salah Issa
Min Xiao

Session Chairs:

Session	Student Chair	Faculty Chair
Machine Systems & Agricultural Systems Management	Jeremy Robison	Dr. Dennis Buckmaster
Bio-Energy	Leyu Zhang	Dr. Michael Ladisch
Environmental & Natural Resources Engineering	Laura Ortiz de Zarate	Dr. Sara McMillan & Dr. Jane Frankenberger
Biological and Food Process Engineering	Wenjie Liu	Dr. David Umulis

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Faculty Chair:
Dr. Abigail Engelberth

The symposium organizers would like to thank to the Purdue Graduate Student Government for their generous support of this event.

We are grateful to the following companies for their participation in the event:

We would like to thank the following local businesses for donating gift cards for poster competition prizes:

Town & Gown bistro

Greek's Pizzeria 1969 It's Our Taste!

Restauration

9 Irish Brothers Traditional Irish Pub

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Professor Joe's Sports Pub & Pizzeria

We would like to acknowledge the support for guest speakers:

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DOW Dow AgroSciences

S Y M P O S I U M S C H E D U L E

Location – Discovery Learning Research Center (DLRC)

9:00 – 9:30 am	**Registration and presentation set-up – *DLRC Atrium***	
9:30 – 10:30 am	**Machine Systems/Agricultural Systems Management Session – *DLRC 221***	**Bio-Energy Session – *DLRC 228C***
	Breidi: Actively controlled digital pump/motor **Bianchi:** Control strategies oscillation reduction in hydraulic load handling machines **Haria:** Optimal control and performance based design of the blended hydraulic hybrid **Hawkins:** Data Integrity Zones Can Improve Agricultural Yield Data Quality	**Santos:** Effect of lignin on cellulose activity **Aghazadeh:** Liquid-liquid extraction to remove *Saccharomyces cerevisiae* inhibitors: incorporating with a commercial scale biorefinery **Orrego:** Enzyme catalyzed disassembly of corn kernels **Kim:** Production of cellulosic ethanol from corn pericarp
10:30 – 10:45 am	***Break***	
10:45 – 12:00 pm	**Networking with Industry Representatives – *DLRC Atrium***	
12:00 – 12:15 pm	***Break***	
12:15 – 1:15 pm	**Plenary Speaker and Lunch – *DLRC 131* Professor Sabine Brunswicker – Director of the Research Center for Open Digital Innovation, Purdue University**	
1:30 – 2:30 pm	**Environmental & Natural Resources Engineering Session – *DLRC 228C***	**Biological Engineering & Food Processing Session – *DLRC 221***
	Bell: Urban stormwater control measures affect stream water quality **Chen:** Urbanization impacts on surface runoff of the contiguous United States **Hodaj:** Evaluation of the two-stage ditch as a best management practice **Cho:** Spatially distributed long-term rainfall-runoff generation and routing using a continuous SCS CN method-based hybrid hydrologic model	**Xiang:** Identification of antimicrobial peptides from soy protein **Dunn:** Health and stress monitoring of long-duration exploration crews on simulated Mars in Hawaii **Narayanan:** Harnessing cell substrate sensing towards effective scaffold-based skeletal muscle regeneration **Du:** PEGylation effects on the complexes formation of dextran derivatives and α-lactalbumin
2:30 – 3:00 pm	***Break***	
3:00 – 5:30 pm	**Poster Session – *DLRC Atrium***	
5:30 – 6:00 pm	***Break***	
6:00 – 8:00 pm	**Keynote Speaker and Dinner – *DLRC 131* Nick Gray – Director of Strategic Projects at Dow AgroSciences**	

SYMPOSIUM GUEST SPEAKERS

Plenary Speaker:

Professor Sabine Brunswicker is an internationally recognized innovation researcher and thought leader with a particular interest in open innovation and innovation ecosystems. She is an Associate Professor of Innovation and Director of the Research Center for Open Digital Innovation (RCODI) at Purdue University. She is also a visiting professor at ESADE Business School, Spain. Throughout her career, Brunswicker has been contributing to the innovation landscape through various engagements with governments, firms, non-profits, entrepreneurs and citizens. Brunswicker was a founding member of IMP³rove, an international initiative of innovation management, and has been instrumental in European standardization and accreditation activities related to innovation management. Today, she is a member of the Open Innovation Strategy and Policy Group (OISPG) of DG Connect, and holds further advisory and jury positions in the private and public sector.

Keynote Speaker:

Nick Gray has served as the Director of Strategic Projects at Dow AgroSciences since 2012 where he is tasked with driving long-term improvements to the organization and operations of one of the top three agricultural companies in the world. Throughout his 32 years at Dow AgroSciences, Gray developed a diverse background in biology, research, product development, project management, and human resources across many cultures. After working in field science and product development, he served in leadership roles in human resources in Europe for over a decade. In 2006, Gray was appointed Vice President of Human Resources where he oversaw a 40% increase in Dow AgroSciences' global workforce and the addition of a business platform. In his current role as Strategic Projects Director, he has lead a number of initiatives designed to increase clarity and deliver speed and agility in company operations

P O S T E R D I R E C T O R Y

Poster #	Student Name	Research Area
1	Iris Feng	ASH
2	Salah Issa	ASH
3	Amanda Kreger	BIOE
4	Antonio Santos	BIOE
5	Barron Hewetson	BIOE
6	Daehwan Kim	BIOE
7	David Orrego	BIOE
8	Hu Shi	BIOE
9	Iman Beheshti	BIOE
10	Mahdieh Aghazadeh	BIOE
11	Neal Hengge	BIOE
12	Sayan Biswas	BIOE
13	Emma Brace	BE
14	Jocelyn Dunn	BE
15	Kok Zhi Lee	BE
16	Mario Cano	BE
17	Naagarajan Narayanan	BE
18	Ning Xiang	BE
19	Ravindra Shrestha	BE
20	Soo Jung Ha	BE
21	Yi Li	BE
22	Yuan Lyu	BE
23	Ahmed Hashem	ENR
24	Andi Hodaj	ENR
25	Colin D. Bell	ENR
26	Colleen Moloney	ENR
27	Garett Pignotti	ENR
28	Jingqiu Chen	ENR
29	John Houtman	ENR
30	Lawrence Sekaluvu	ENR
31	Natalie Chin	ENR
32	Ronald Smith	ENR
33	Sam Noel	ENR
34	Samaneh Saadat	ENR
35	Sanoar Rahman	ENR
36	Sushant Mehan	ENR
37	Tian Guo	ENR
38	Younghyun Cho	ENR
39	Ashley Wondergem	FP
40	Enrique Busquets	FP
41	Farid Breidi	FP
42	Hiral Haria	FP
43	Jordan Garrity	FP
44	Lizhi Shang	FP
45	Matteo Pellegri	FP
46	Riccardo Bianchi	FP
47	Achint Sanghi	FOOD
48	Amudhan Ponrajan	FOOD
49	Jinsha Li, Gnana Prasuna Reddy Desam	FOOD
50	Juan Du	FOOD
51	Shreya N. Sahasrabudhe	FOOD
52	Yumeng Zhao	FOOD
53	Darren Seidel	MACH
54	Elizabeth M. Hawkins	MACH

Research Area Key

ASH = Agricultural Safety and Health
BIOE = Bioenergy
BE = Biological Engineering
ENR = Environmental and Natural Resources
FP = Fluid Power
FOOD = Food Process Engineering and/or Food Safety
MACH = Machine Systems

1 Quality of weather data and effect of sow activities on ammonia emissions from IA4B gestation barns

Iris Feng, ASH
Advisor: A. Heber

As the world's second largest pork producer, U.S. pork production accounted for approximately 10% of global production which has produced over 118 million heads over 2013. Ammonia emission from animal housing, manure treatment, storage facilities and land application has become a global issue since it causes negative impacts on environment and ecology including the soil acidification, water eutrophication and fine particular matter. The National Air Emission Monitoring Study (NAEMS) involved in several sow farms were monitored for two years of quality-assured field data. A sow farm data from NAEMS with two gestation barns and one farrowing barn which was located at Jasper County, IA (IA4B) has been detailed analyzed in this study. Weather station data near the site has been imported and compared with onsite data to enhance the data quality and completeness. Data of animal activities has been normalized to analyze and define the diurnal patterns of sow behavior. Furthermore, the effect of sow behavior on ammonia emissions from the gestation barns has been evaluated.

2 The effects of grain type and condition on the force needed to extricate a victim

Salah Issa, ASH
Advisor: W. Field

Grain entrapments and engulfments are one of most common hazards associated with grain storage facilities and since the 1970's over 1100 incidents have been documented. Previous studies have calculated the force needed to extricate a victim from various depths of entrapment. However, these research studies focused on idealized situations. The objective of this research is to investigate the amount of force experienced by a mannequin extricated from a variety grains including corn, soybeans, wheat, oats, canola seeds, sunflower seeds and popcorn. These grains were selected to represent a wide variety of shapes, sizes and types of grain in addition to the three most common grains found in a grain entrapment (corn, soybean and wheat). The experiment was conducted using a small scale representation of a mannequin and a grain bin. Some of the findings include: extrication forces from the surface of the grain increased by 54% in high moisture corn (22%) vs dry corn (15%). Pulling the mannequin at 45 degree angle increased the extrication force from 8% to over 50% depending on the type of grain used. The force needed to pull a victim were significantly different based on the type of grain with the largest amount experienced in popcorn, canola seeds and soybeans. In conclusions, these results indicate that it is critical to test the effort needed to extricate a victim on a variety of grains and conditions before developing safety recommendations. Future research would include conducting these experiments using a life-sized mannequin.

3 Variability in Cell Wall Content for Lignin Modified Poplar

Amanda Kreger, BIOE
Advisor: N. Mosier

Lignin modified Arabidopsis plants show significant differences in plant cell wall composition and susceptibility to enzymatic and chemical treatments; however, Arabidopsis is not ideal for larger scale bio feedstock use. To examine lignin modification use in a bio feedstock suitable plant, plant cell wall composition was analyzed for eight lignin modified poplar variants with differing S and G lignin compositions. The resulting compositions were used to make predictions in susceptibility to chemical treatments. Poplar samples were depolymerized using a two-step acid hydrolysis treatment. The hydrolyzed sample monosaccharides were analyzed in detail using high performance liquid chromatography. Remaining hydrolyzed samples were analyzed gravimetrically for soluble lignin, insoluble lignin, and ash content. We report that total carbohydrate content (67.35% ± 0.38%) is identical across seven of the eight variants and that glucan, xylan, and acetyl subcomponent composition is also identical in these seven variants. We also report variation in total lignin content and in soluble lignin and insoluble lignin subcomponents across all eight variants. A slight trend (R^2 = .34) exists between a variant's soluble lignin subcomponent and its previously determined S lignin content. Variation in lignin deconstruction, observed as variation in soluble and insoluble lignin subcomponents, suggests susceptibility to acid treatments may differ between poplar variants and that variants with higher S lignin composition may be more susceptible to acid treatments. In addition, lignin modification was shown to have no effect on carbohydrate composition for a majority of samples, demonstrating that lignin modification can be completed without essential carbohydrate content loss.

4 Effect of lignin on cellulose activity

Antonio Santos, BIOE
Advisor: M. Ladisch

Lignocellulose is composed of polysaccharides linked to lignin and other aromatic compounds, making the sugars not readily available for fermentation. For this reason, biomass must go through the unit operations of pretreatment and enzyme hydrolysis. Pretreatment opens the structure to allow the enzymes to act on cellulose and hemicellulose, which are thereby hydrolyzed to glucose and/or xylose which in turn are fermented to ethanol. Concomitantly, the enzymes interact with soluble phenols and insoluble solids derived from lignin that inhibit hydrolysis. This leads to high enzyme loadings and higher production costs. Soluble phenols can be eliminated through washing. Insoluble lignin, however, demands another approach. Using bovine serum albumin (BSA) and pretreated sugarcane bagasse, the effect of blocking solid lignin from adsorbing enzymes during hydrolysis was evaluated. Hydrolysis was carried for 72 hours, using 6.25 FPU (Cellulase 13P) and 12.5 IU (Novozyme 188) /g solids (10 mg protein/g solids) at pH 4.8 and 50°C. The conversion was generally higher when BSA was present, 51% (±1%) vs 42% (±1%) with 1.5% solids loading and 46% (±1%) vs 40% (±1%) with 8% solids loading. The use of BSA produced an increase in the final conversion (p-value < 0.01), but conversion decreased as loadings increased. This has been observed in multiple other studies and cannot be

explained by a single factor. The basis of this phenomenon is being investigated.

5 Analysis of Delignified Biomass Treated with Phosphoric Acid (P-Ma/Al) For Hydrolysis and Continued Conversion of Cellulose and Lignin to Chemical Intermediates

Barron Hewetson, BIOE
Advisor: N. Mosier

The development of catalytic methods for the direct conversion of biomass to high value chemicals and liquid fuels offers an alternative to petroleum based feedstock. To achieve the best efficiency with such processes, robust treatments that can break down and utilize the entire set of complex biopolymers found in plant matter must be developed. The objective of this poster is to illustrate the advancements made through collective focus on catalytic depolymerization followed by a selective systematic approach to simultaneously upgrading lignin and cellulose to desired products. The use of the P-Ma/Al catalytic conversion system served as a measuring technique for determining hydrolysis rates.

6 Production of Cellulosic Ethanol from Corn Pericarp

Daehwan Kim, BIOE
Advisor: M. Ladisch

In this research, we present a new concept in enzyme-based deconstruction of the corn kernel into its base components of starch, pericarp, germ, oil, and sugars. This approach also provides fermentable sugars as another high value stream for production of ethanol. The added cellulase enzyme mixture is developed to minimize hydrolysis and recover up to 90% of the starch from the kernel in an identifiable particulate form, with intact pericarp being recovered as well. The recovered pericarp is then liquefied to yield cellulose derived sugars that may be fermented to additional ethanol. This approach takes advantage of every part of the kernel in order to increase the revenues of the process, and to introduce cellulose ethanol production into existing corn to ethanol facility. This research gives an overview of corn kernel composition, it's fractionation into separate and identifiable components, and fermentability of generated sugars in liquefied samples using Saccharomyces cerevisiae NRRL Y-1546. We report how the sugars in liquefied solution can be effectively fermented to ethanol with the yeast that close to the maximum theoretical yield of ethanol.

7 Enzyme catalyzed disassembly of corn kernels

David Orrego, BIOE
Advisor: M. Ladisch

Our work addresses the goal of developing new uses for corn and relating it to ethanol industry. The research focus on an enzyme-based processing that deconstructs the kernel into its base components of starch, pericarp, germ (and oil), and sugars, and then transforms the sugars into value-added molecules using catalytic processing. High-value chemicals that can be produced from corn-derived sugars include furans, levulinic acid, biohydrocarbons, succinic acid and sugar alcohols. These add significant value through product diversification. By the optimization of conditions for the combined use of commercial protease with cellulase, we have enabled close to 90% recovery of the starch found in a corn kernel in a particulate form after 36 hours of incubation. A cone-bottoned bioreactor was used to scale-up the production of particulate starch at temperatures that do not exceed 50°C. While formation of some sugars still occurs, the resulting glucose may be readily fermented to ethanol in an existing fermentation processes typical of a corn dry mill facility, while the starch is recovered by centrifugation or filtration. Conditions for the proposed enzyme based disassembly process are compatible with a corn dry mill.

8 Reduction of Aflatoxin in Corn by High Voltage Atmospheric Cold Plasma (HVACP)

Hu Shi, BIOE
Advisor: K. Ileleji, R. Stroshine

Aflatoxins are naturally occurring toxic contaminates in grains that could cause cancer, affect immune system and reduce the growth rate of animals that consumes the grains. The technology of High Voltage Atmospheric Cold Plasma (HVACP) generates non-thermal plasma and is widely used for decontamination in medical, material and food processing. This study investigates the effectiveness of HVACP on reduction of aflatoxin in corn, the influence of relative humidity (RH 5, 40, 80%), treatment time (1, 2, 5, 10, 20, 30 min), gas type (Air, MA65) on aflatoxin reduction was investigated. The Ozone and NOx concentration was measured for each treatment using Dragger tubes. The experiment shows that all the factors have a significant effects, Aflatoxin in corn follows logarithmic reduction by the HVACP treatment. Greatest reduction of aflatoxin was achieved with RH 40%, longest treatment time (30min), and gas MA65. The effect of RH and gas type on performance of cold plasma was further investigate with UV-Vis spectra. The UV-Vis emission spectra of the plasma revealed emission bands for nitrogen and oxygen species, such as O, O+, N, and N+. Relative humidity lowered the emission intensity of emission bands. Increasing treatment time from 0 to 10 min increases the Ozone and NOx concentration to saturation status with no change when treatment time is further increased from 10 to 30min. Higher concentration of Ozone and NOx concentration were generated with gas MA65 than air. Increasing relative humidity results in lower Ozone and NOx concentration.

9 Hydroxyl radical oxidation of celluloses using phenolic catalyzed ozone reactions

Iman Beheshti, BIOE
Advisor: N. Mosier

Hydroxyl radicals (•OH) can play a role in two different processes involving lignocellulosic material. They can react with C=C double bonds and phenolic compounds in lignocelluloses to degrade the lignin in the pretreatment stage. The •OH radicals can also oxidize the hydroxyl groups in cellulose to induce charged carboxylate bonds on the cellulose surface. Oxidation reactions can have applications in surface modification of cellulose nanofiber production. Ozone gas is an efficient oxidizing agent yet ozone alone is relatively ineffective in oxidizing cellulose surfaces. Addition of hydroxyl radical promoters to ozone gas has proven to initiate reaction with cellulose surfaces

by inducing carbonyl groups. Lignin and its residual byproducts (in pulp) have been found to be an efficient catalyst in •OH radical formation when ozone gas is applied to biomass and pulp. This implies that lignin degradation byproducts namely phenolics from an ozone lignocellulosic pretreatment process can be added to a latter cellulose oxidation step in production of cellulose nanofibers from biomass enzymatic hydrolysis residue. In this study we propose we examine efficacy of lignin-derived phenolics as catalysts to activate ozone for oxidation of the cellulose surface and characterize the resulting cellulose nanomaterials in wet and dry state. Thecatalyzed ozone oxidized nanocellulose is compare with TEMPO-Cellulose Nanofibers (CNF).

10 Liquid-Liquid Extraction to Remove Saccharomyces cerevisiae Inhibitors: Incorporating with a Commercial Scale Biorefinery

Mahdieh Aghazadeh, BIOE
Advisor: A. Engelberth

The lignocellulosic biomass conversion process to bioethanol involves pretreating the woody structure of the biomass. Along with making the polymeric sugars more accessible for enzyme digestion, pretreatment steps release many other compounds (acids, furans, and phenolics) that can act as inhibitors for fermentation. Our laboratory results show that liquid-liquid extraction removes most of the known inhibitors and reduce their concentration in the pre-fermentation broth below their inhibition threshold. Extensive studies have been performed to select an organic solvent with the lowest miscibility with the biomass liquid hydrolysate. The biocompatibility of the organic solvents with Saccharomyces cerevisiae strain (NRRL Y-1546) has also been tested and ethyl acetate was selected as the solvent with highest biocompatibility and extractability.

Techno-economic analysis was performed to evaluate the practicality of the extraction system incorporation with an operating second-generation biorefinery. The results indicate compatibility with the biorefinery and that it is competitive with the other common separation techniques if the proposed solvent has high recovery ratio.

The laboratory work, computer simulation, and techno-economic analysis results confirm the hypothesis that our system, consisting of ethyl acetate production reactor, extraction column, and adsorption unit, has the feasibility to be incorporated within a second-generation bioethanol refinery.

11 Enzymatic Liquefaction of Untreated Corn Stover

Neal Hengge, BIOE
Advisor: M. Ladisch

Cellulosic feedstocks such as corn stover are promising renewable sources for ethanol production. However, improvements to processing biomass at high solids concentrations are needed in order for cellulosic ethanol to become economically viable. This work examines the feasibility of carrying out biomass liquefaction in order to enhance lignocellulosic pretreatment. The goal is to convert solid biomass into a reactive and pumpable slurry that can be readily hydrolyzed and fermented to ethanol. Liquefaction does not aim to form monomeric sugars. Rather, enzymes that target cellulose chains internally and randomly (endoglucanase) to produce shorter chained molecules are desired. Milled corn stover was added to a buffer at pH 4.8 and 50°C containing an endoglucanase-rich fraction. When hourly fed batch addition was used, a pumpable slurry of up to 200 g/L of corn stover was obtained. This result depended on both selection of enzyme and agitator design. We present here an analysis of slurry properties as they relate to the objective of attaining a pumpable slurry. Biomass slurries with viscosities in the range of 500 cP at 50°C and shear rate of 4.8 1/s have been observed at solids concentrations of 200 g/L. Subsequent pretreatment and enzymatic hydrolysis of liquefied material will be discussed as well. These results will stimulate the search for liquefaction process improvements to increase final ethanol yields.

12 Clean Combustion Strategy: Ignition of Ultra-Lean Hydrogen and Natural Gas by Hot Reacting Jet

Sayan Biswas, BIOE
Advisor: L. Qiao

Depleting oil reserve, stringent emission regulations for oxides of nitrogen (NOx), unburned hydrocarbons (UHC) and an effort to increase thermal efficiency demand high proficiency combustion techniques. Meeting such strict regulations for cleaner combustion and demanding performance require manufacturers to move toward ultra-lean operation, which would reduce the peak combustion temperature and thereby reduce NOx formation. An experiment has been developed to investigate the ignition characteristics of ultra-lean premixed hydrogen/air and natural gas/air by a reacting turbulent hot jet generated by prechamber combustion. The apparatus adopts a dual-chamber design that a small-volume (1% of main chamber volume) prechamber with stoichiometric fuel/air resides within a large-volume main chamber containing lean fuel/air. A small diameter orifice, 0.5 mm to 5 mm diameter, connects two chambers. A spark ignites the prechamber fuel/air resulted a hot reacting jet that ignites the main chamber. Compared to a conventional spark plug, the resulting hot jet has a much larger surface area i.e. multiple ignition sites on its surface which can enhance the probability of successful ignition and lead to faster heat release rates in the lean mixture. Results illustrate existence of two ignition mechanisms: jet ignition and flame ignition with significant increase in lean limit and lower NOx emission. Simultaneous high-speed Schlieren, OH* chemiluminescence, Infrared imaging, Schlieren PIV have been applied to visualize the jet penetration and the ignition processes inside main combustion chamber. The velocity and temperature variations of the jet for various prechamber volumes, orifice geometries, and initial pressures have been studied to find the

13 Enhanced Bioseparations through Molecular Modeling with COSMO-RS

Emma Brace, BE
Advisor: A. Engelberth

The market for bio-based products from plant sources is on the rise. There is a global challenge to implement environmentally clean practices for the production of fuels and pharmaceuticals from sustainable resources. A significant hurdle for discovery of comparable plant-derived products is the extensive amount of trial-and-error experimentation required. To alleviate the experimental burden, a molecular modeling approach known as the COnductor-like Screening MOdel for Real Solvents (COSMO-RS) was used to predict how to purify six silymarins from an aqueous mixture using a two-phase solvent system. Silymarins are a class of flavonolignans present in milk thistle (Silybum marianum L.), which has been used in traditional eastern medicine to treat liver disease. Previous research has shown that these compounds can be fractionated using centrifugal partition chromatography (CPC), but not to an acceptable level of purity making these compounds ideal to test the molecular modeling approach to predict partitioning in a CPC separation. COSMO-RS was used to calculate the activity coefficients of the silymarins in each solvent system, based on the molecular structure of the compounds and phase partitioning data gathered from gas chromatography. The activity coefficient was then used to calculate a partition coefficient for each silymarin in each solvent system. The partition coefficient was verified by experimentation and compared to the results of the model. Use of the COSMO-RS method allowed the range of possible solvent systems to be quickly narrowed down, reducing the amount of experimentation and the time required to achieve results.

14 Health and Stress Monitoring of long-duration exploration crews on simulated Mars in Hawaii

Jocelyn Dunn, BE
Advisor: S. Landry

To prepare astronauts for long-duration space travel, such as missions to Mars, it is critical to develop an understanding of how long-term isolation and confinement can impact astronaut health and performance. Toward this goal, Hawaii Space Exploration Analog and Simulation (HI-SEAS) conducts simulated Mars missions in an off-grid, sustainable habitat located on the slopes of Mauna Loa volcano in Hawaii. An eight-month HI-SEAS mission has recently concluded and a 12-month mission is ongoing, which are part of a series of missions researching the biological, psychological, and social adaptations that occur on simulated Mars. My research has two main objectives: 1) investigating the impacts of stress on health and performance of astronauts and 2) developing methods for health monitoring and stress management through the use of advanced wearable technology and biological sampling.

15 Reprogramming bacterial stress responses for improved biofuel and value-added chemical production

Kok Zhi Lee, BE
Advisor: K. Solomon

Microbes are attractive platforms to produce biofuels and other value-added chemicals from renewable resources. Many products, however, are toxic to the cell and induce a stress response that promotes survival of the organism at the expense of production. While mutants with altered stress responses have been isolated for the production of these compounds, many of these strains grow poorly, lowering overall process yields. We aim to dynamically reprogram this stress response to better balance cellular growth and product formation for improved biofuels and value-added chemical production. We are developing a CRISPRi knockdown library that will allow us to sample a number of phenotypes that protect E. coli against the toxic effects of target compounds. The programmable nature of CRISPRi also offers a convenient sequence barcode that maps these phenotypes to individual genes and allows us to identify the genes that protect against product toxicity. In parallel, we are constructing a fluorescent reporter system in E. coli to monitor cellular stress and evaluate the environmental parameters (e.g. temperature, pH, chemicals) that affect cellular health and limit production. We will analyze stressed cells via proteomics and RNASeq to identify key proteins/genes involved in the response and elucidate the specific pathways that are triggered by these cues. This integrated approach of library screening and –OMICS based analysis will provide tools to reprogram bacterial stress responses for improved production of biofuels and value-added chemicals.

16 Engineering Polymer-based Drug Delivery System for Inductive Browning of Adipocytes.

Mario Cano, BE
Advisor: M. Deng

The global epidemic of obesity and its associated risks of chronic diseases affect > 10% of the world's population. One of the promising strategies to reduce obesity and its negative metabolic consequences, is transformation of white adipocytes into beige adipocytes (browning) through the inhibition of the Notch signaling pathway. However, Notch inhibitors are well known for its multiple side effects after systemic administration by conventional drug delivery systems. Biodegradable polymer-based drug delivery systems enable sustained, spatio-temporally controlled drug release, and offer several unique advantages over conventional drug delivery including continuous drug release, decreased systemic side effects, and increased patient compliance. Here, we present the development of novel biodegradable polymeric particulate drug delivery systems from a FDA approved polymer, poly(lactide-co-glycolide) (PLGA) for sustained and local release of a Notch inhibitor, DBZ. In vitro studies demonstrated the capability of these systems to encapsulate and deliver DBZ in a controlled manner. Cellular studies showed that the DBZ delivered from these systems inhibited Notch and promoted browning of white adipocytes. Furthermore, injection of these DBZ-loaded PLGA particules into mouse inguinal white adipose tissue depots resulted in browning in vivo. In summary, the PLGA-based particles are potential candidates to act as controlled drug delivery systems for treatment of obesity by modulation of Notch signaling.

17 Harnessing Cell Substrate Sensing Towards Effective Scaffold-based Skeletal Muscle Regeneration

Naagarajan Narayanan, BE
Advisor: M. Deng

Skeletal muscle injuries and muscle degenerative diseases pose a significant challenge to the healthcare. Current cell-based therapies are ineffective due to poor cell survival rate and the lack of supportive cell environment (cell niche). Scaffold-based tissue engineering provides a potential alternate strategies to overcome limitations in the current therapies. Scaffolds provide a supportive environment by mimicking the extracellular matrix (ECM) properties. Skeletal muscles are characterized by aligned arrays of muscle fibers, which constitute the local microenvironment. Fabricating scaffolds mimicking the aligned muscle fiber architecture is important in enhanced regeneration of skeletal muscles. Biophysical cues such as such surface topography provides critical contact guidance for dynamic cell material interactions. In the present study, we have systematically investigated the role of the curvature of the scaffold fibers on myoblast responses by fabricating polymeric fibers with varying fiber diameter from nano-scale to micro-scale. Cell adhesion, proliferation and differentiation were characterized using in vitro cell culture. Myoblast cells responded to the changes in surface curvature as evidenced form the cellular responses. Results indicated that micro-scaled fibers supported enhanced contact guidance for myoblast alignment, elongation, proliferation and differentiation when compared to the nano-scaled fibers. These studies provide important design guidelines for optimizing scaffold biophysical properties for effective muscle regeneration.

18 Identification of Antimicrobial Peptides from Soy Protein

Ning Xiang, BE
Advisor: G. Narsimhan

Antimicrobial peptides (AMPs) inactivate microbial cells through pore formation in cell membrane. Because of their different mode of action compared to antibiotics, AMPs can be effectively used to combat drug resistant bacteria in human health. AMPs can also be used to replace antibiotics in animal feed and immobilized on food packaging films. In this research, we developed a methodology based on mechanistic evaluation of peptide-lipid bilayer interaction to identify AMPs from soy protein. Production of AMPs from soy protein is an attractive, cost-saving alternative for commercial consideration, because soy protein is an abundant and common protein resource. This methodology is also applicable for identification of AMPs from any protein. Initial screening of peptide segments from soy glycinin (11S) and soy β-conglycinin (7S) subunits was based on their hydrophobicity, hydrophobic moment and net charge. Delicate balance between hydrophilic and hydrophobic interactions is necessary for pore formation. High hydrophobicity decreases the peptide solubility in aqueous phase whereas high hydrophilicity limits binding of the peptide to the bilayer. Out of several candidates chosen from the initial screening, two peptides satisfied the criteria for antimicrobial activity, viz. (i) pore formation in transmembrane state of the aggregate as assessed by one and two dimensional water density profile across the bilayer as well as two dimensional peptide density profile and (ii) lipid-peptide binding in surface state, as evaluated by all-atom molecular dynamic (MD) simulation. Their antimicrobial activity against Listeria monocytogenesis and E.coli was further confirmed by spot-on-lawn test.

19 Human-Centered Design of Crop Drying Solutions for Smallholder Farmers

Ravindra Shrestha, BE
Advisor: K. Ileleji

For cereal grains, the value of quantitative post-harvest losses (PHL) in the continent is estimated at more than US$4 billion annually . Poor post-harvest practices and the lack of a low-cost, effective drying technology in the humid tropics are major causes of high PHL and aflatoxin contamination in maize (corn). Data collected using a community driven culture-centered approach (CCA) showed that the lack of a low-cost effective drying technology was the single limiting factor causing high PHL, high aflatoxin contamination and low agricultural productivity in the major maize production regions (Ashanti and Brong-Ahafo) in Ghana. This is also a primary problem in the humid tropics of the world, which encompasses Africa, the Americas and Asia, and is home to 2.9 billion people, mostly poor, who depend on agriculture as their primary source of livelihood. We present an innovative energy efficient crop drying approach, which is based on observing a clever crop drying practice of smallholder farmers' during cooking. The key is to ensure that solutions for smallholder farmers are human centered by aligning engineering solutions with their cultural practices, while providing a low-cost holistic approach.

20 Lipidomic Analysis and Current Treatment Studies of Human Glioblastoma

Soo Jung Ha, BE
Advisor: K. Clase

Glioblastoma (GBM) is the most common and malignant form of primary brain tumors. It is highly invasive and current treatment options have not improved the survival rate over the past twenty years. Novel approaches and technologies from systems biology have the potential to identify biomarkers that could serve as new therapeutic targets for GBM.

This study employed lipid profiling technology to investigate lipid biomarkers in ectopic and orthotopic human GBM xenograft models. Primary human cell lines, GBM10 and GBM43, were injected into the flank and the right cerebral hemisphere of NOD/SCID mice. Tumors were harvested from the brain and flank and proteins, metabolites, and lipids extracted from each sample. Reverse phase based high performance liquid chromatography coupled with Fourier transform ion cyclotron resonance mass spectrometry (LC-FTMS) was used to analyze the lipid profiles of tumor samples. Statistical and clustering analyses were performed to detect the differences.

Over 500 lipids were identified in each tumor model and lipids with the greatest fold effect in the comparison of ectopic versus orthotopic tumor models fell predominantly into four main classes of lipids: glycerophosphoserines,

glycerophosphocholines, glycerophoshpoethanolamines, and triradylglycerols. Significantly decreased amount of lipids in glioblastoma tumor samples indicate that lipids may play a critical role in tumor development such as a fuel source for cancer proliferation. These results underscore the importance of the surrounding physiological environment on tumor development and the critical role of specific classes of lipids in GBM tumor growth in different anatomical sites.

21 Validation of Mycobacteriophage Genome Annotation by Mass Spectrometry

Yi Li, BE
Advisor: K. Clase

The fundamental knowledge of phage has led to many applications in biotechnology. Phages are engineered to be nano-carriers for drugs and anti-bacterial agents based upon their target specificity and simple virion structure. The limited information of phage-host interactions and expression of phage proteins, however, constrains maximizing their full potential for biotechnology.

The life cycle of a phage begins with attachment to the host cell. After injecting genomic DNA into a bacterium, a phage may further enter either lytic or lysogenic cycle. In lytic cycle, the phage replicates DNA and produces virions by hijacking host machinery, eventually resulting in lysis and the release of virions. The lysogenic cycle is distinct from lytic cycle, as phage DNA is integrated into the bacterial chromosome and replicated during bacterial cell division. Under certain conditions of a lysogenic cycle, the phage DNA can be released from the host chromosome and subsequently enter a lytic cell cycle.

Previously, we reported a novel mass spectrometry (MS) method that facilitated the identification of peptides produced in phage-infected Mycobacterium smegmatis (M. smegmatis) culture. We conducted further analysis by searching mass spectra in six-reading frames of the phage genomes as reported by Pope et al, 2014, and detected many unexpected out-of-frame peptides that were not predicted by the genome annotation (manuscript in preparation). We hypothesize that the peptides we observed were produced in response to specific phases in the growth cycle of the host and highlight the importance of examining the phage-host system in more detail. In order to test

22 Pore formation by aggregates of melittin in 1,2-Dioleoyl-sn-glycero-3-phosphocholine (DOPC) and 1,2-di-(9Z-octadecenoyl)-sn-glycero-3-phospho-(1'-rac-glycerol) (DOPG) mixed lipid bilayer by molecular dynamics Simulation

Yuan Lyu, BE
Advisor: G. Narsimhan

Antimicrobial peptides (AMPs) kill microbial cells through insertion and damage/permeabilization of the cytoplasmic membranes. They can target multiple microorganisms and may not allow the bacteria to develop resistance thereby making them an attractive alternative to antibiotics. Pore formation in DOPC/DOPG bilayers by antimicrobial peptide melittin was investigated by explicit solvent molecular dynamics (MD) simulation to mimic their permeation action on the cell membrane of microorganism. The effects of number and orientation of melittin inside the lipid bilayer on the formation of water channel (pore) was characterized. The minimum number of peptides required for pore formation is compared with the critical pore size predicted by a mathematical model based on the free energy of pore formation.

23 Comparison of field scale Remotely Sensed ET with FAO crop-coefficient based ET

Ahmed Hashem, ENR
Advisor: V. Bralts, B. Engel

Evapotranspiration (ET) is one of the major components of the water budget. The main goal of this research is to compare field scale remotely sensed evapotranspiration with crop-coefficient based ET. Remotely sensed evapotranspiration with Landsat (30 m) spatial resolutions was estimated for the St. Joseph River Basin, specifically the ALG site in Cedar Creek Watershed, near Waterloo, IN, USA. The area of ALG is around 20 km2 with a weather station located approximately at the center of the ALG site. Corn and soybeans are the major crops in the basin, and most fields are managed under dryland conditions. A few fields are equipped with center-pivot irrigation systems for supplementary irrigation when needed. The Bushland Evapotranspiration and Agricultural Remote Sensing System (BEARS) was used to derive ET using Landsat data for the summer growing season (April 1st to October 31st) for 4 years from 2008 to 2011. For selected irrigated dryland fields, comparisons of estimated remotely sensed ET against crop-coefficient based ET were explored. The remotely sensed ET was generally lower than the FAO crop-coefficient based ET, as the FAO approach uses well irrigated grass for calculation of potential ET, and this has limitations in dry lands. The uncertainty of remotely sensed ET ranged from 5% to 65 % based on the accuracy of the estimation method, spatial resolution and cloud cover.

24 Evaluation of the two-stage ditch as a best management practice

Andi Hodaj, ENR
Advisor: L. Bowling

Artificial drainage has long been an important component of agriculture in the poorly-drained regions of the US Corn Belt. Continued increases in drainage intensity funnel more water into existing drainage ditches, resulting in higher flood stages, more erosive water velocities and decreased time for in-channel nutrient processing. The two-stage ditch is a type of in-stream restoration that involves modification of a trapezoidal drainage ditch to resemble more the features of a natural stream. The idea is to create or simulate extended benches on both sides of the ditch that would develop naturally over a period of time in a stream because of geomorphological processes. These in-channel flood plains provide a greater flow area during high flow events and offer the potential to reduce sediment load and extend the interaction time between water and vegetation on the benches, allowing larger uptake of nutrients and increasing the denitrification rates in the bench soil. The Soil and Water Assessment Tool (SWAT) hydrologic model has recently been modified to represent the two-stage ditch as a conservation practice. Processes that are

represented in the model include: velocity reductions due to the change in channel geometry, particle settling, plant nutrient uptake and denitrification on the benches of the two-stage ditch. The model is evaluated using data collected from a two-stage ditch constructed at the Throckmorton Purdue Agricultural Center (TPAC) near Lafayette, Indiana in September 2012. It drains an area of approximately 2.7 km2 of farmland used for corn and soybean production. Simulation results for 30 years

25 Urban stormwater control measures affect stream water quality

Colin D. Bell, ENR
Advisor: S. McMillan

Urbanization increases export of biologically reactive solutes (i.e., nitrate (NOx), total dissolved nitrogen (TDN), orthophosphate (PO_4) and dissolved organic carbon (DOC)) and disturbs stream ecosystems. Stormwater control measures (SCMs) mitigate the impacts of urbanization, and therefore have the potential to improve stream water quality. The goal of this research was to understand the effects of SCMs on in-stream concentrations of nutrients and carbon during storm events in two urban and two suburban watersheds in Charlotte, NC. We measured solute concentrations of SCM water and a mixture of stream+SCM water during baseflow and 47 storms from 2011-2012. Average concentrations during stormflow were greater than baseflow, indicating that storms are potential hot moments for solute export. Land use was an important control on export of nitrogen and phosphorus, as event mean concentrations (EMC) of TDN and NOx were higher at sites with less forest coverage, and EMCs of PO_4 were higher at the two suburban sites which likely receive more applied fertilizer. At the two urban sites, SCM water reduced in-stream concentrations, whereas SCM water increased in-stream concentrations at the suburban sites. In the suburban watersheds, we were unable attribute this rise to either the addition of urban surface runoff or SCM mitigation because an increase in impervious area coincided with addition of SCMs. Taken together, these results suggest SCMs have the potential to act as hot spots for transforming stream water quality, but the water quality implications vary depending on the type, location, and extent of urban development in the watershed.

26 Modification of SWAT tile drainage simulation and evaluation using measured tile flow

Colleen Moloney, ENR
Advisor: J. Frankenberger

As nutrient reduction strategies become more dependent on model output, ensuring the processes simulated in these models are correct has become a huge undertaking. SWAT tile drain and water table calculations have been altered several times and the current version has not been tested at a small scale using measured tile flow. Data from tile-drained fields at the Southeast Purdue Agricultural Center (SEPAC) is being used to evaluate tile flow simulations. This poster will show: (1) issues with the current release of the SWAT routines, (2) improvements to the algorithms determining water table and tile drain volume, and (3) an application of these improved routines on tile-drained fields at SEPAC.

27 Evaluation of SWAT Soil Water Content Model Output and Sensitivity

Garett Pignotti, ENR
Advisor: M. Crawford, I.Chaubey

Given in situ observations of soil water content are limited by cost and spatial coverage, remotely sensed observations, model simulations, or some combination of both are often utilized in predictive analysis of ecohydrologic systems. It is therefore critical to capture the accuracy and practical limitations of such model or remotely sensed estimates. In particular, soil water dynamics in the Soil and Water Assessment Tool (SWAT) model have not been extensively evaluated with respect to accuracy nor interaction with other model variables and governing equations. Therefore, the objectives of this research seek to: 1) compare SWAT simulated soil water content to observed in situ and remotely sensed measurements and 2) evaluate SWAT model sensitivity to soil water content. Research was conducted at the Little River Experimental Watershed (LREW) near Tifton, Georgia, where 29 soil moisture stations with measurements at 3 depths are employed. Remotely sensed soil moisture data was obtained from a multi-sensor, active/passive merged soil moisture data product from the European Space Agency's Essential Climate Variable (ECV) program. Simulated soil water content time series from a SWAT model was compared to both measured observations. Sensitivity was assessed for various SWAT hydrologic, water quality, and plant growth subroutines and outputs where results were examined relative to land use and soil classifications. It is expected that results from this analysis will aid in evaluating the accuracy of SWAT simulated water content as well as identifying possible areas for more targeted and rigorous model evaluation or improvement.

28 URBANIZATION IMPACTS ON SURFACE RUNOFF OF THE CONTIGUOUS UNITED STATES

Jingqiu Chen, ENR
Advisor: B. Engel, M. Gitau

Urbanization has significant impacts on hydrologic processes, water quantity, and water quality. Research related to urbanization impact on surface runoff has been focused on changes at the watershed scale. Unfortunately, quantitative assessment at a national scale is scarce. This study applied a newly developed version of the Long-Term Hydrologic Impact Assessment (L-THIA) model named L-THIA Tabular Tool, which can be used as a toolbox in ArcGIS with high calculation efficiency, to assess urbanization impacts on average annual surface runoff of the contiguous United States based on the National Land Cover Database (NLCD) for 2001, 2006 and 2011. The results revealed that: 1) urbanization occurred non-homogeneously across the nation in the decade from 2001 to 2011; 2) urban expansion and intensification served as main driving forces altering surface runoff and resulting in more medium and very high runoff counties; 3) the majority of counties in the contiguous U.S. could be categorized as low runoff counties that had long-term normalized average annual runoff depth (NAARD) values less than 17.8 mm within the decade from 2001 to 2011; 4) NAARD values of the top ten NAARD states in 2011 were jointly influenced by high

precipitation and increases in urban land, while the top ten NAARD change percentage states in 2011 were mainly distributed in the western U.S. with low precipitation and their NAARD values were mainly influenced by large increases in urban land; 5) nationally, about 3.3 billion cubic meters of average annual runoff were gained due to urbanization from 2001 to 2011.

29 Optimal Design and Plan of Modified Hydroponic Shipping Container

John Houtman, ENR

Advisor: R. Stwalley

As the world's population moves toward urbanization, more innovative methods for growing food must be investigated for changing conditions. Within these methods, there are many engineering and design factors that will be instrumental to feeding the growing population: cost of transportation, food security, sustainability and freshness. My research focuses on urban agriculture and design to grow food in non-traditional spaces. Hydroponic shipping container units are commercially available, but little empirical study has been established on the efficiency of these units from design to production. The major research goal is to complete a renovated shipping container unit into a hydroponic system ready for production. This hydroponic unit will utilize nutrient enriched water and lighting systems as inputs. PVC pipes will house the plants and environmental control in four subunits within the shipping container unit will be a major determinant of the design methodology. Throughout the design process, a main focus is on modularity and system flexibility in order to find the most optimal system comparable to those commercially available. For example, in order to find the best flow rate that adequately supplies nutrients to the plants given an established unit area of light and other inputs, each growing sub-unit will be adjustable for slope and height. By designing this hydroponic shipping container to contain variable methods of production, further research will allow for optimization of production according to plant type, location, and capital intensity, and lead to a better advantage in feeding a growing population.

30 Accuracy of Topographic index models at prediction of Ephemeral gullies in Central Kansas.

Lawrence Sekaluvu, ENR

Advisor: M. Gitau

Topographic index models have been incorporated in planning tools for installation of best management practices to reduce soil erosion within watersheds. The performance of topographic indices may vary depending on the geomorphology and topography of the watershed. Six topographic index models were used at prediction of ephemeral gullies (EGs) in two paired watersheds with different levels of terrain disturbances. The Running Turkey watershed has 179m of grassed waterways, and 525m of terraces, while Dry Turkey watershed has 379m of grassed waterways, and 1900m of terraces. The EGs predicted each model were compared with observed EGs obtained using field reconnaissance and aerial imagery. The optimum thresholds for the models were obtained based on EG length, EG location, and catchment drainage density. The results indicate that watersheds experiencing higher disturbances in topography will have higher optimum topographical thresholds as compared to watersheds with less disturbances. The optimum thresholds obtained through classification of head water (HW) and main stem catchments (MS) using drainage density analysis within Running Turkey watershed were similar to those obtained using EG length and location analyses. However, within Dry Turkey watershed, there was a disagreement in optimum threshold values for HW and MS. The optimum thresholds were obtained at 2.3 for MS catchments, and 3.1 for HW catchments. The accuracy of topographic index models from watershed to watershed might be attributed to topographical alternations within the watershed other than the location of the watershed.

31 Using Scenario Development to Encourage Tourism Business Resilience in the Great Lakes

Natalie Chin, ENR

Advisor: K. Cherkauer

Tourism is an economic sector anticipated to be greatly affected by climate change, but the potential impacts of climate change on tourism have rarely been examined in detail in existing research. Past research has shown, however, that the small and medium businesses that dominate the tourism sector could be greatly impacted by climate change. We have presented global climate and hydrologic model research results to pre-selected coastal tourism business owners in the Great Lakes region to determine the best methods for delivering user-friendly future climate scenarios, given that existing research suggests that climate change adaptive behaviors and resilience increase with information (message) clarity. Model output analyses completed for this work have focused on temperature, precipitation, and extreme weather events due to their economic impact on tourism activities. We have also experimented with the development and use of infographics because of their ability to present information quickly and clearly. Initial findings of this work will be presented as well as lessons learned from stakeholder interactions. Two main results include that (1) extreme weather events may have more meaning to tourism business owners than general trends in climate and (2) long-term planning for climate is extremely difficult for tourism business owners because they operate on a much shorter planning timeline than those generally used for climate change analyses.

32 Development of a Novel Modified Shipping Container Unit for Hydroponic Vegetable Crop Production

Ronald Smith, ENR

Advisor: R. Stwalley

Population growth, urban sprawl, and land degradation will increase demand for food, fuel, and fiber closer to the points of consumption in the near future. Controlled environment urban agriculture is a potential remedy to address these grand challenges. Engineered modular solutions such as shipping containers have

been proposed to produce food in an ecologically efficient manner, while maximizing input material efficiencies. Comparative empirical testing of commercially available, however, units is limited. The overall goal of this study is to deter¬mine the crop production potential of a modified hydroponic shipping container (MHSC) unit for use in climactic conditions representative of the Midwest US, specifically Indiana. The Purdue University Agricultural and Biological Engineering - Urban Agriculture Initiative (PU ABE-UAI) is currently developing a modified shipping container unit for vegetable crop production. The specific goals of this project are to 1) develop and refine metrics for evaluating and comparing controlled environment systems (MHSC and greenhouse production) for production potential, productivity, and material resource utilization under predefined basic production conditions; 2) to design and develop long-range testing protocols for the controlled environments systems; and 3) to compare the dedicated shipping container unit with a greenhouse unit according to predeveloped metrics using the testing protocols. The engineering foci of the PU ABE-UAI is sustainable design, assembly, operation and maintenance and broader educational outcomes. It is hoped that data will be generated will accurately assess yield potential for controlled environment and crop production systems to improve food security using innovative solutions.

33 The Trials Tracker App: For Synchronized, Mobile Yield Data Analysis of On-Farm Trials

Sam Noel, ENR

Advisor: D. Buckmaster

Farmers are presented with an array of products and approaches that promise to improve their operation. If properly documented, tests with samples of these products could be treated as on-farm research trials. The potential to evaluate a decision at the time of harvest is a moment that often goes unrealized by farmers because they did not have the means to quickly and properly document the trial or perhaps even because the data must be exported and taken to a computer to analyze.

The Trials Tracker app is an open-source tool that aims to empower farmers by streamlining the process of analyzing their yield data. The app encourages farmers to investigate their options by allowing them to compare the results of their trials. The app also aims to demonstrate OADA's vision of improved synchronization between data sources and the tools used to inform management decisions.

Through a simple note-taking interface, users may describe the trial before drawing a polygon of the trial area on a map. After harvest, the user is presented with the average yield value associated with each trial which they may then compare to the rest of the field across one or more years. Users may also tag their trials with their own descriptors and compare across trials by these tags. An OADA server will host real farm yield data to demonstrate the flow of yield data to the app, even allowing for real-time access to data as it is harvested and uploaded to the cloud.

34 Nitrate and Phosphorus Losses from an Agricultural Drained Field in Indiana under Free and Controlled Tile Drainage

Samaneh Saadat, ENR

Advisor: J. Frankenberger, L. Bowling

Controlled drainage can reduce nitrate and phosphorus losses to drain flow, but the effects may vary in different farm fields. The goal of this study is to quantify the impact of controlled drainage on drain flow, nitrate and phosphorus load from subsurface tile drainage over a multi-year period on Davis Purdue Agricultural Center (DPAC) in eastern Indiana. The drainage site at DPAC has two controlled and two free draining plots equipped with electromagnetic flow meters (Krohne Waterflux 3070) that have a unique approach for measuring bidirectional flow at very low flow levels as well as high flow levels since 2011. ISCO auto samplers were used to draw samples every hour in each quadrant to monitor water quality. Difference in load is then calculated using paired watershed approach.

35 Reconstruction of Naturalized Daily Streamflow for the Upper Wabash River

Sanoar Rahman, ENR

Advisor: L. Bowling

During the 1960s, the United States Army Corps of Engineers (USACE) constructed a number of dams in the Upper Wabash watershed in Indiana, primarily for flood control. In order to investigate the impact of environmental changes, such as changes in land management and climate on streamflow, it is necessary to know what would be the natural streamflow without the influence of reservoir management. Historic daily streamflow data were used to estimate daily naturalized streamflow for six sites in the Upper Wabash basin using a modified drainage-area ratio (DA) method and maintenance of variance extension type 1 (MOVE.1) method. Model performance was evaluated for a period of observed streamflow before dam construction and naturalized flow was computed for the period 1968 to 2014. The DA method resulted in a better estimation for most of the stations and it was more consistent compared to the MOVE.1 method. To get the best naturalized streamflow at each site, different values for exponents of the drainage-area ratio (α) were used. 1.07 as an exponent (α) resulted in overall good estimation, with bias varying from -1 to 4% across all the stations. Reservoir management in the Wabash Basin has altered daily and seasonal flow dynamics, but annual flow volume was not effected. Naturalized streamflow hydrographs show sharper early spring peaks compared to observed streamflow. There is an increasing trend in low and mean streamflow across the upper Wabash River watershed, as well as an increasing trend in the Richards-Baker Flashiness Index (RBI).

36 Effect of colored mulches in mitigating climate change impacts on growth of Capsicum under field conditions

Sushant Mehan, ENR

Advisor: M. Gitau, R. Sharda, K. Singh

The adversity of changing climate can be realized in shifting cropping patterns and poor productivity of the crop. Shifting planting/sowing dates requires complete manipulation of crop to withstand the

adversities of non-conducive environment. The remedy is to manipulate crop environment for sustenance of crops and to avail them with sufficient crop growth factors so that they can grow well. The biodegradable colored plastic mulches has proven to be a powerful tool in modifying the plant environment and is possible viable option. In this study, a field experiment which was the randomized complete block design was laid out at research experiment station at PAU, Ludhiana with four different colored mulches with three replications each on raised bed 120 cm wide and 20 m long using mulch laying machine. Nurseries were transplanted in staggered pattern. Mulches were able to change the micro climate in such a way that not only crop was able to sustain for longer but also attained better phenotypic growth and quality of fruits in comparison to control plot. The mulches were able to provide optimum soil temperature for the roots and shoots to grow and sufficient light in PAR region that increased the yield of fruit over the grey on black mulch to nearly 2 times of yield obtained in control. Moreover, the crop was grown with sub surface drip irrigation system, there was seen, a substantial conservation in terms of soil moisture as well. From all treatments studied, Grey on black mulch was considered to be best.

37 Comparison of performance of tile drainage routines in SWAT2009 and SWAT2012 in the Little Vermillion River Watershed

Tian Guo, ENR
Advisor: B. Engel

Subsurface drainage systems are common practices in agricultural watersheds in the Midwest area of the US. Soil and Water Assessment Tool (SWAT) has been used to model watersheds with tile drainage. However, research on simulating hydrologic processes and nutrient losses by tile drainage routine in SWAT2012 was rare. This study used long-term monitoring field site and river station data from LVRW to evaluate performance of tile drainage routines in SWAT2009 revision 528 and SWAT2012 revision 615. Calibrated monthly tile flow, surface flow, nitrate-N in tile and surface flow, sediment and annual corn and soybean yield results from SWAT with both tile drainage routines were compared with observed values. Statistical analysis such as percent error (Pbias), coefficient of determination (R2), Nash-Sutcliffe efficiency (NSE), the modified NSE and Kling-Gupta efficiency (KGE) were calculated. Generally, both routines provide acceptable simulated tile flow (NSE = 0.50 ~ 0.68), and nitrate in tile flow (NSE = 0.50 ~ 0.77) for field sites, while routine in revision 528 simulated poor tile flow (NSE = -0.77~ -0.20) and nitrate in tile flow results (NSE = -0.99 ~ 0.21) for field site with constant tile spacing. The results provided reasonable parameter sets of the old and new routines in LVRW and showed that the new routine in revision 615 has potential to accurately simulate hydrologic processes in mildly-sloped watersheds.

38 Spatially distributed long-term rainfall-runoff generation and routing using a continuous SCS CN method-based hybrid hydrologic model

Younghyun Cho, ENR
Advisor: B. Engel

A continuous SCS CN method which can consider time-varied SCS CN values was developed based on the original SCS CN method with a revised soil moisture accounting approach to estimate runoff depth for long-term discontinuous storm events. Then, it was applied to hydrologic simulation for spatially distributed long-term rainfall-runoff flow prediction using Distributed-Clark (hybrid hydrologic model), the GIS-based spatially distributed Clark's unit hydrograph method, introducing conditional unit hydrograph adoption for different runoff precipitation depth-based flow convolution. Case studies of long-term (total of 6 years) Distributed-Clark simulation for four river basins using spatially distributed NEXRAD radar-based daily precipitation demonstrate overall performances of ENS 0.62, R2 0.64, and PBIAS 0.33% in direct runoff and ENS 0.71, R2 0.72, and PBIAS 0.15% in total streamflow for model result comparison against observed streamflow, and these show better fit (ENS of 42.0% and R2 of 33.3% increase in total streamflow) than the same model applications using spatially averaged rainfall data. Also, logic for conditional initial abstraction in a continuous SCS CN method, which can accommodate amounts of initial abstraction in accordance with previous rainfall, slightly enhances model simulation performance; both ENS and R2 increased by 1.4% for total streamflow in a 4-year calibration period. Thus, a continuous SCS CN method-based Distributed-Clark is a useful technique to conduct long-term hydrologic application, particularly for spatially distributed rainfall-runoff generation and routing.

39 The Improvement of the Lubricating Gaps of Axial Piston Machines Via Surface Shaping

Ashley Wondergem, FP
Advisor: M. Ivantysynova

Axial piston machines of the swashplate type are often used in numerous hydraulic systems especially so with recent developments in displacement control. With the common use of such machines it is essential to maximize efficiency further reducing operation costs as well as improving performance and reliability. In terms of efficiency, the essential load bearing lubricating gaps in positive displacement machines are the main source of energy dissipation; accounting for up to 60% of losses at full displacement and 90% at low displacement. However, the design of such interfaces can be a tedious, expensive task through significant trial-and-error testing. Therefore, the focus of this research is to not only reduce the energy dissipation of the lubricating gaps, but to also improve the load support of the fluid film through the exploration of innovative surface shaping design principles utilizing a novel fluid structure thermal interaction model.

40 Energy Efficient Displacement-Controlled Hydraulic Hybrid Excavator

Enrique Busquets, FP
Advisor: M. Ivantysynova

The excavator prototype has been a demonstrator of highly efficient fluid power technologies since the inception of the NSF center for compact and efficient fluid power. Following predictions based on system simulations and and measurements conducted by CAT Inc., significant fuel savings have been demonstrated on the prototype though

the use of displacement control (DC), a highly efficient throttle-less actuation technology developed by M. Ivantysynova, over the standard excavator system. Over the past few years, efforts have been focused on demonstrating a novel hydraulic hybrid configuration with pump switching. The series-hybrid architecture introduces secondary controlled actuation for the swing drive in combination with the implementation of an energy storage system in parallel to the other DC actuators for the remaining working functions. Such architecture enables energy recovery from all actuators, capture of swing braking energy and up to 50% engine downsizing. The pump switching architecture introduces a distributing manifold that acts as a logic element to minimize the installed pump power while maximizing the number of actuators available to the operator. This architecture leverages fuel savings above those demonstrated with the non-hybrid DC excavator prototype and the reduction of production costs and improved reliability.

41 Actively Controlled Digital Pump/Motor

Farid Breidi, FP
Advisor: J. Lumkes

Current state-of-the-art variable displacement pump/motors have high efficiencies when operating at high displacements. However, as the displacement of the pump/motor is reduced, the efficiency significantly decreases. Digital pump/motors aim to increase the efficiency of the fluid power system by minimizing leakages, friction losses and compressibility losses. It is based on the concept of electrically controlling two high speed on/off valves connected to each displacement chamber. A 3-piston digital pump/motor simulation model was developed to perform design optimization studies and a unit was built to experimentally validate the model, design, and operating strategies. The simulation analysis and experimental results show that the sequential flow limiting strategy yields the lowest power loss in both pumping and motoring and that small variances in the valve response cause a significant drop in unit efficiency. While electrically controlled valves allow for greater flexibility of independent valve control, mechanically actuated valves present an opportunity to reduce complexity of the control system, so a single lever mechanically actuated pump/motor design is being investigated to achieve variable displacement at high efficiency.

42 Optimal Control And Performance Based Design Of The Blended Hydraulic Hybrid

Hiral Haria, FP
Advisor: M. Ivantysynova

Due to rising fuel prices and regulations on emissions there has been an expanding interest in hybrid vehicle research. Though the focus has been in electric hybrid vehicles, hydraulic hybrids show great potential owing to their higher power density, higher efficiency in regenerative braking, and lower cost of materials. Many different hydraulic hybrid architectures have been proposed, one of the most common being the series hybrid. The hydraulic units in series hybrid being connected directly to the high pressure accumulator operate inefficiently at low displacements and high pressures in many cases. Additionally the driver's torque demand can exceed that available from the accumulator's current pressure and fluid must be pumped into the accumulator to raise the pressure. This results in a delay in meeting the demand and yields a sluggish response.

To address these issues the blended hydraulic hybrid was introduced. Using dynamic programming, an optimal control simulation tool, it showed improved efficiency and response when compared to the series hybrid. It achieves high efficiency and fast response partially through hydrostatic transmission whereas regenerative braking and blending of engine and accumulator power are realized through a combination of valves.

With promising results, a blended hydraulic hybrid SUV was designed and constructed. In preparation for this, a new sizing methodology to determine transmission sizing that meets both the efficiency and performance requirements was developed. To explore the trends in sizing a full factorial combination of hydraulic unit and accumulator sizes and accumulator minimum pressures were optimally controlled for UDDS cycle using

43 High Performance Valve Actuation Systems

Jordan Garrity, FP
Advisor: J. Lumkes

The goal of this project is to develop a high performance actuation mechanism to move things very quickly, precisely, and reliably. For fluid power systems these 'things' are very fast valves with large flow rates to create new systems, and to improve the performance and efficiency of existing systems. Today's valves are capable of either a large flow rate, or a fast response. Expensive multiple actuation stages and pilot pressure is needed when trying to simultaneously achieve a large flow rate in a fast valve. The concept described here, removes the need for expensive components to attain a high performance and is based on quickly connecting a moving mass to a stationary mass to cause the stationary mass to move very quickly, transferring energy between the two masses. The stored actuation energy (such as a rotating mass) is intermittently connected and disconnected to produce linear or rotary motion in the primary actuator. This coupling action is done utilizing the friction (fluid shear) properties of Magnetorheological (MR) fluid as it is exposed to a magnetic field. Controlling the magnetic field strength allows for a variable actuation force driving the valve open or closed thus making it proportional in stroke length. Three prototypes have been tested experimentally to compare with simulated results. A 7mm stroke in 7ms has been measured in the laboratory. Future work includes addressing the challenges of incorporating this actuator into a hydraulic valve for experimental testing.

44 Axial Piston Machine Modeling and Ports Temperature Calculation

Lizhi Shang, FP
Advisor: M. Ivantysynova

This poster is going to present an ongoing research study conducted in Maha fluid power research center to model the fluid film behaviors of axial piston hydraulic machines. This modeling study provides the knowledge of the physical phenomena

of the fluid film behaviors includes the pressure distribution, temperature distribution, and viscosity distribution in the fluid film, the solid body deformation under both the pressure and thermal load, the heat transfer in the solid body. This modeling study also includes the ports temperatures calculation which based on both the temperature changing due to the fluid compression and expansion and the heat transfer between the fluid and the solid parts. To verify the model, the modeling results of this study are also compared with the measurement data.

45 Modelling of Hydrostatic Units: the case of Gear Pumps

Matteo Pellegri, FP

Advisor: A. Vacca

The increasing demand of the market of more and more efficient pumps and motors combined with the necessity of reduction of project costs heavily required by the manufacturer, pushed the R&D division of Fluid Power companies to look for money-and-time efficient alternatives to the nowadays available solutions, especially, when the cost has to be kept at minimum. Hydrostatic units, such as external gear machines and Gerotor pumps, need to fulfill these requirements. In this presentation, an innovative and novel approach for modelling these kind of units will be described in details taking the particular cases of HYGESim (Hydraulic Gear Machine Simulator) and GeSiT (Gerotor Simulating Tool). HYGESim and GeSiT are powerful tools developed at Maha Fluid Power Research Center during several years of research. Based on a multi domain approach, these tools couple the description of characteristic flow of the machine with a mechanical module in which the interaction of the unit's components can be evaluated accordingly to the loads generated by the fluid dynamics inside the machine. An accent will be put on how the micro-motions of the rotors, play a fundamental role in the characterization of such units. Experimental validation of these models, has proven that such tool can be used for studying and optimizing existing pump designs and for the creation of innovative and alternative ones.

46 Control Strategies Oscillation Reduciton in Hydraulic Load Handling Machines

Riccardo Bianchi, FP

Advisor: A. Vacca

Hydraulic machines suffer from many kinds of vibrations, like mechanical vibration, cabin vibration and payload oscillations, that can be transmitted through the machine to the operator and shorten the life of the machine and cause potential health hazards for the operator, due to the low frequency and high amplitude nature. Many control methods have been proposed in the last century, but all require the knowledge of the model of the machine, which is always a long step in the design of a new machine.

Also control systems often require the position of sensors in dangerous areas on load handling machines, where they can be exposed to the operating condition of the machine, therefore one purpose of the controllers proposed is to use pressure sensors, which can be kept in a safe position, to extend the reliability and the life of the component.

In this article, it is shown different integrable approaches with non-model based methodologies to reduce the time to market and increase the control system flexibility in new machines, presenting control methods for mechanical and payload active vibration damping based on online pressure feedback for the frequency identification.

47 Computational Fluid Dynamics Simulation of a solar cabinet dryer

Achint Sanghi, FOOD

Advisor: K. Ambrose

Drying grains to a safe moisture content is crucial to preventing losses and deterioration during storage. In many developing countries open air sun drying is the most commonly used method of drying. However, this method is inefficient in humid climates, and in any case is labor-intensive and detrimental to the final product quality. Access to conventional sources of energy such as fossil fuels or electricity may be limited, in which case mechanical dryers which require these as fuel sources are not viable. An alternative proposition is to use a solar dryer which can supply more heat than is available at ambient conditions. Although a number of designs for solar dryers already exist, quantitatively assessing their performance is difficult due to variabilities in weather conditions and product nature. Understanding the effects of different design changes experimentally is time consuming and difficult, if not impossible, due to these variabilities. Computational Fluid Dynamics (CFD) is a design tool which can be applied to study solar dryers and understand the impact of design changes. In this work, a natural convection, mixed-mode solar cabinet dyer loaded with approximately 20 kg of white maize is modelled and simulated using ANSYS Fluent. The model incorporates ambient weather and crop conditions as inputs to simulate the drying process. The model is validated by comparing results to experiments, and can then be used to explore the effect of design changes on the performance of the dryer.

48 Identifying process parameters to produce pre-cooked flour from various grains using a single-screw mini-extruder for ready-to-use therapeutic foods (RUTF)

Amudhan Ponrajan, FOOD

Advisor: M. Okos

A 60 lb/hr single screw mini-extruder, originally developed for NASA to cook grains in resource constrained environments, is currently being researched on to produce foods for developing countries. Operated by a 7.5 hp electric motor, the extruder solely utilizes viscous heat dissipation from high shear screw sections to cook the grains. The primary focus of this work was to utilize this extruder to produce pre-cooked soybean, white dent corn, yellow waxy corn, oats, pearl millet, sorghum, teff, wheat, green pea, garbanzo bean and lentil flours which will be incorporated in ready-to-use therapeutic food (RUTF) formulations for Ethiopia, Ghana and Pakistan. The general pre-extrusion processes involved dehulling and sieving whole grains, milling to appropriate particle size and moisture equilibration for appropriately feeding the extruder. All the grains were extruded in a moisture content (wet basis) range of 30% to 35%, except soybeans which was extruded at 10% moisture content. The screw speed of

the extruder was identified for the individual grains and was in the range of 300 RPM to 900 RPM to produce pre-cooked flours. The die temperature measured for all the grains ranged between 1150C to 1200C except soybeans which were extruded at a die temperature of 1600C. Post extrusion, the extrudate was dried to 10% moisture content then milled into flour for use in the RUTF.

49 Prediction of Swelling Kinetics of Waxy Native Maize Starch

Jinsha Li, Gnana Prasuna Reddy Desam, FOOD
Advisor: G. Narsimhan

Starch pasting behavior greatly influences the texture of a variety of food products such as canned soup, sauces, baby foods, batter mixes etc. The annual consumption of starch in the U.S. is 3 million metric tons. The overall goal of this investigation is to characterize the relationship between pasting behavior of starch and its structure and composition. In this research, evolution of granule size distribution of waxy native maize starch when subjected to heating at constant temperatures was characterized using Static Laser Light Scattering . The structure of waxy maize starch was characterized by molecular weight distribution and second virial coefficient as obtained from light scattering as well as by transmission electron microscopy. Polymer solution theory was applied to predict the evolution of average granule size of starch at different heating rates in terms of its molecular weight, second virial coefficient and granule elasticity and compared with experimental data. The results from this investigation will provide information with regard to the connection between the structure, composition and architecture of the starch granules and its pasting behavior in order to arrive at a rational methodology to design modified starch of desirable rate of digestion and texture.

50 PEGylation effects on the complexes formation of dextran derivatives and α-lactalbumin

Juan Du, FOOD
Advisor: O. Jones

Block ionomer complexes (BICs) as core-shell structured micelles are a type of polymer-surfactant nanomaterials formed by charge interactions. In our study, assembling between whey protein alpha-lactalbumin (a-lac), and carboxymethyl-dextran-block-poly(ethylene glycol) (CMD-b-PEG) or carboxymethyl dextran (CMD) are used for complex formation. The successful modification of CMD, CMD-b-PEG as dextran derivatives are confirmed by nuclear magnetic resonance spectroscopy (NMR). Acid titration was used for complex formation with mix of a-lac and CMD or CMD-b-PEG. The BICs formed by a-lac and CMD-b-PEG involve reacting segments of anionic CMD as block ionomer, PEG as non-ionic water soluble segments (block copolymer), and oppositely charged a-lacIn contrast, the assembling between a-lac and CMD lacks the block copolymer of PEG and could not form stable BICs. The successful assembling between a-lac and CMD or CMD-b-PEG with different molar ratios are confirmed through the measurements of turbidity, light scattering, zeta-potential, and transmission electron microscopy (TEM). Light scattering intensity measurements indicates that complexation occurred at higher pH of the a-lac and CMD-b-PEG complex samples in comparison to the a-lac and CMD samples. TEM images confirms the a-lac and CMD-b-PEG complex formation with size ranges from 20-50nm by radius, which is in agreement with the results from dynamic light scattering. Visible light turbidimetry measurement shows that the molar ratios of a-lac to CMD have significant impact on the pH of phasing but not in the samples of a-lac and CMD-b-PEG complex, due to the lack of PEG as hydrophilic block copolymer. The controlled delivery properties of this BICs system is

51 Determination of Interfacial Tension for Commonly Used Food Oils at Elevated Temperatures

Shreya N. Sahasrabudhe, FOOD
Advisor: B. Farkas

Immersion frying is a widely used technique to process food by heating in oil above 100˚ C. During frying, there is simultaneous heat and mass transfer causing the food to absorb oil as it loses moisture in the form of steam. The rate of heat transfer, moisture loss and oil uptake are all affected, in part, by interfacial tension (IFT) between the oil, steam and food surface. The goal of the study is to understand the relationship between frying oil temperature and interfacial tension in systems containing oil, surfactants and water. For the first part of the study, pendant drop technique was used to measure oil-air IFT for five cooking oils (canola, soybean, corn, olive and peanut). A goniometer (KRÜSS GmbH.) fitted with a temperature controlled chamber and an elevated temperature syringe (Ramé-hart instrument co.) were used to make IFT measurements from room temperature (24±2˚ C) to 200˚ C at intervals of 20˚ C. All IFT values decreased linearly as temperature increased ($R^2>0.99$) from a maximum of 31.95 mN/m (Olive oil at 23.5°C) to a minimum of 21.29 mN/m (Peanut at 200°C). IFT trends were similar for all oils but values were statistically different between oils ($p<0.0001$). The coefficient of variation for quadruple measurements at each temperature was between 0.1-0.9 percent indicating the precision of the method. The data generated from this study can be used for analysis of processes involving food oils at high temperatures such as frying.

52 Effect of different tempering methods on sorghum milling

Yumeng Zhao, FOOD
Advisor: K. Ambrose

Effect of cold water, hot water and stream tempering on sorghum kernel physical properties and texture were studied. Sorghums were tempered by steam treatment under pressure of 40 psi with different duration, cold water under room temperature and hot water at 60°C to 18% moisture content. Single kernel characteristics (SKCS) and abrasive hardness of sorghum kernels were studied after each tempering treatment. SKCS hardness is based on crush force and abrasive hardness was estimated based on the time (seconds) to remove 1% of kernel weight during decortication. The results indicate that hot water and steam tempered kernel hardness was less than the cold water tempered sorghum grains. The SKCS-hardness were 63.70, 62.33 and 61.19, respectively for cold water, hot water, and steam tempered kernels at

same moisture level. Abrasive hardness decreased with increase in hot water tempering time . During steam tempering, SKCS-hardness was decreased with increasing treatment time. When the tempering time was increased from 1min to 2.5min, the hardness decreased from 64.97 to 50.58. However, steam tempering time had opposite effects on abrasive hardness. As steam time increased, abrasive hardness increased significantly. This indicate that steam tempering could toughen the outer layer of kernels while decrease the kernels resistance against crush force. The results of hardness values with steam tempering reveals that steam tempering could make kernels break easily during milling process assisting better separation of bran and endosperm.

53 Identifying Origins of Fecal Load in Urbanized Sections of the Concho River, Tom Green County, Texas

Darren Seidel, MACH
Advisor: J. Ward, Angelo State University

Seasonality has shown to play an extremely responsible role in the fluctuation of Escherichia coli (E. coli) loading on the Concho River System in San Angelo, Texas. However even with temperature change and other physicochemical parameters varying with seasonal change, several sites exceed EPA's "safe versus unsafe for contact" surface water standard by three to ten times the respected < 320 colony forming units per 100 mL standard threshold value (at 3.2%). The objective of this project is to quantify areas of E. coli loading to further understand local sources of bacteria pollution. Ten sites located along highly urbanized sections of the Concho River will be sampled for E. coli and physiochemical properties including temperature, dissolved oxygen, specific conductance, conductance, total dissolved solids, and pH. The data set will encompass twenty-six sampling periods spread out over a year. The E. coli data will be used to isolate areas where Bacteroidetes identification DNA markers will be sampled for birds, humans, and dogs. After the Bacteroidetes analysis is conducted, results will yield species specific data to determine the main source(s) of contamination. This project gives way to putting a numerical and biological answer to pollution of an urbanized surface water system with eight dam structures located within the area of interest.

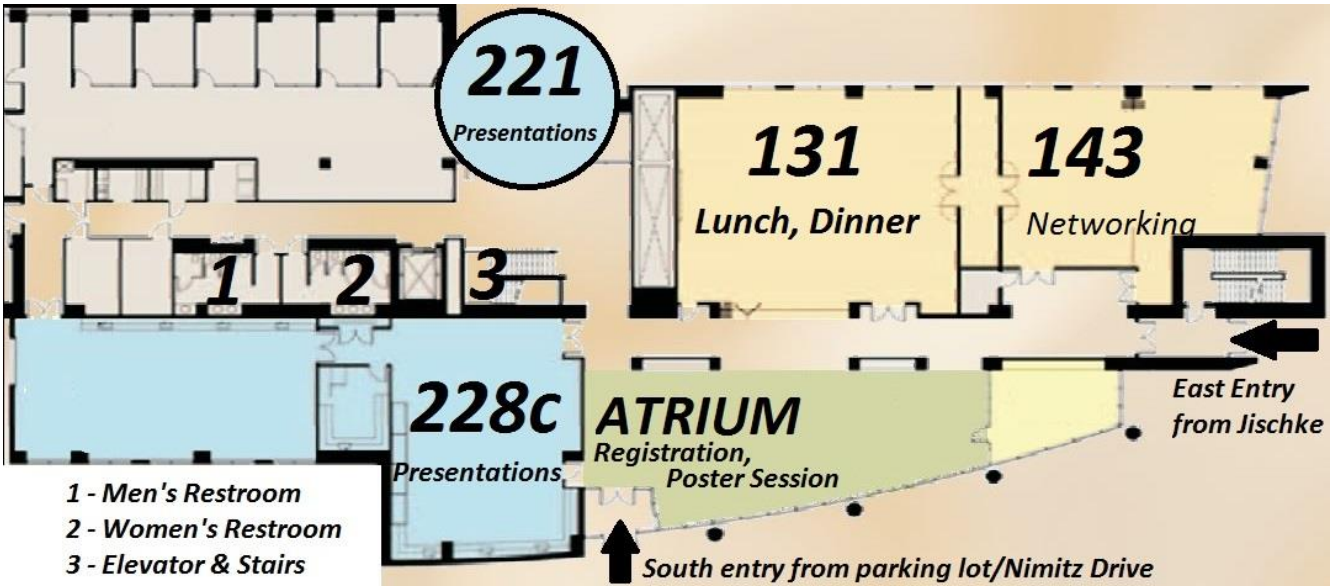
54 Data Integrity Zones Can Improve Agricultural Yield Data Quality

Elizabeth M. Hawkins, MACH
Advisor: D. Buckmaster

The greatest challenge facing the agriculture industry today is increasing production to feed a growing population while reducing costs, inputs, and impact to the environment. Precision agriculture has long promised improved efficiency through the application of new farming technologies; however, the true impact of these technologies has not been yet realized, in part due to the lack of data available to effectively employ these technologies. Big data is currently being touted as the solution to this problem, but the application of these advanced analysis techniques present new challenges of their own. Data quality is a primary concern when using these techniques for decision-making and as the amount of data grows, data quality will become even more crucial. One approach is to use a smaller, more accurate subset of data collected in data integrity zones (DIZ) for analysis and interpretation of multi-temporal yield data. These zones are determined by utilizing descriptive metadata to identify areas within a field where errors and artifacts in the data are likely to be reduced. Data in DIZ were isolated and the reduced datasets were used to compare yield results over nine years. Yield response across years was investigated to determine if this approach can increase the power to accurately detect and interpret yield differences for making management decisions. This novel approach could enable the application of traditional statistical tools for on-farm research and larger scale yield trials, as well as give insight into improving data quality to feed future big data analytical models.

Map of the Discovery Learning Research Center (DLRC).

Please note the 2nd floor has been overlaid on the first floor.



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